Ph.D. Synopsis

Assessment of Ground water Quality and identification of ground water potential zones in the Aundha Nagnath tehsil, District Hingoli, Maharashtra , India, Using Geospatial and AHP Techniques.

To submitted to
SWAMI RAMANAND TEERTH MARATHWADA

UNIVERSITY, NANDED

By

RAUT VAISHNAVI SAHEBRAO
Research student
School of Earth Science
Swami Ramanand Teerth Marathwada University, Nanded

Under the Guide

Dr. VASANT M. WAGH

Research Guide in Environmental Science
School of Earth Science
SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
2022

Contents

Abstract: 2
Introduction 2
Groundwater quality 3
Groundwater pollution 3
Geospatial and AHP technicians 4
AHP techniques (Analytical Hierarchy process) 4
Review of literature 4
Study area 4
Objective 6
Methodology 6
Importance of the study 7
International status: 7
National status : 7
Significance of the study 7
Work plan: 7
Structure of research work 8
Reference 9

Abstract:

Groundwater occurrence in hard rock basaltic terrains is restricted to isolate weathered and fractured zones and pockets wherein slow movement of groundwater, prolonged rock-water interactions and higher residence times raise quality issues. Therefore, suitability assessment of groundwater for various purposes becomes imperative in Aundha Nagnath Tehsil. Representative groundwater samples will be collected from the study area during two seasons (pre and post-monsoon) over a span of two years for major cations and anions. The study will undertakethrough hydrological, geospatial, APH techniques to identify groundwater potential zones in the study area. The thematic layers include geology,geomorphology, land use, land cover, soil and slope.The groundwater conditions respond very rapidly to hydrological stress from climatic and human-induced activities as a result groundwater level will monitor from the study area.The outcomes of the study will provide reliable information on source and history of groundwater contaminants, which may help water resource managers to develop basin management plans to improve groundwater quality in the study area. Also, study will useful to identify the groundwater recharge potential zones and propose the suitable types of recharge structures to augment the water table in the study area.

Introduction

Water is fundamental unit of all the organisms and human beings on the Earth. It is essential commodity for biotic and abiotic factors and without waterthere will be no existence of life.Water is used in almost all activities of life support system.It is universal solvent because it is an inorganic, clear, tasteless, odourless, colourless chemical substance, which is the major ingredient of earth'shydrosphere. Water plays an important role in human life. It is used for drinking, industries and agriculture purposes. It is being in liquid form is very useful for maintenance of human body. It has one of the most important ability to dissolve much other substance. It is probably the only natural resources to touch all aspects of human civilization from agricultural and industrial development to cultural and religious value embedded in society (Dehghanpour and Saeed, 2013).It is available in two types ie. Surface water and groundwater.Surface water include in river, glaciers, reservoirs, stream, lakes. Groundwater is also known as sub surface water. Groundwater occurs in weathered portion, along the joints and fractures the rock. Groundwater is derived in two zones, one of the zones of saturation; another is zones of aeration (Todd 2005). Many researchers have reported that appropriate groundwater management plans within watershed requires details information about various parameter like geology, geomorphology, slope, land use and land cover. To identify groundwater recharge potential zones and suitable recharge sites(Sahu et al. 2022).

Groundwater is one of most precious natural water resource within the entire earth, especiallyin the arid and semi-arid regions of the world (Todd and Mays, 2005). Groundwater is playingimportant role in mitigating the domestic and irrigation needs and economical importance to sustaining ecosystem. The groundwater quality and quantity is threatened by natural and anthropogenic inputs include climate change, scarcity and excessive use. Finally, the changing climate condition may pose serious threat on its availability and accessibility to the society on local to global scale (Herrera-Pantoja andHiscock,2008). In the Aundha tehsil, the groundwater is mainly used to cater the needs of drinking water through municipal, rural

water supply, private domestic wells and harnessed for agricultural. Generally, the groundwater condition is worsen very rapidly to hydrological stress from climatic and human-induced activities as a results groundwater level declining day by day in the study area. Groundwater recharge is one of the crucial tasks of climatic factors as rainfall varies, due to change in temperatures and evaporates transportation affected on recharge.

Groundwater quality

Groundwater is most important source and very useful for living organism. Recently growth in population, urbanization and industrialization are mainly responsible for reduce the available water resource and more than 90% of the urban population is depend on groundwater for their drinking and irrigation needs(Gaikwadet.al.2021). The quality of groundwater changes due to many factors including weather, geology, geography, rock water addition and anthropogenic activities (Kadam et al.2021).To study the biological, chemical, physical parameters of groundwater. Colour, odour, taste,salinity, electrical conductivity is known as physical parameters of groundwater. Chemical parameters include electrical conductivity (EC), Total Solids (TS), Total Dissolved Solids(TDS), Total Suspended Solids(TSS);biological parameters include phytoplankton, zooplankton, algae, and protozoa. Minerals of groundwater arsenic, nitrate, and fluoride, photochemical fluoride is the mineral of water high concentration of fluoride then dental and skeletal problems produced in human (Kadam et al. 2020). Fluoride can have both positive and negative impacts on human health.Generally,the high concentration of fluoride in drinking water leads to the dental and skeletal problems in children. According to WHO (1984) and Bureau of Indian drinking standard (BIS, 2012) water requirement the permissible limit of fluoride is 1.5ppm and desirable limit 1.0ppm.Nitrate is one of the most common ground water contaminants in rural area because it excessiveload can cause methemoglobinemia(blue baby disease). Arsenic pollution of drinking water causes a disease known as arseicosis(Wagh et al. 2017). Generally, Symptoms of arsenic is skin cancers, lung cancer, and swollen limbs and lose of feeling to hand and feet.

Groundwater pollution

Groundwater pollution is define as groundwater contamination occurs when man-made products such as fuel, oil, and chemicals get into the groundwater and causes it to become dangerous human use. Materials from the land's surface can move through the soil and end up in the groundwater. It is caused due to natural, agricultural, industrial and other man made source. There are certain ways to minimise groundwater contamination, like proper drainage pipes, safe storage of chemical, safe disposal of waste. Groundwater refers to water collected under the earth's surface. The source of groundwater is rain,snow, sleetetc. Groundwater is connected to surface water such as river, streams. In fact there is continuous exchange of water between surface water and groundwater. In some area,groundwater also serves as the source for irrigation and factories. The sources of groundwater pollutants are natural and man-made. Natural sources are less harmful as compare to man-made and anthropogenic sources. (Arihant publication book)

Geospatial and AHP technicians

Geospatial data is the data about object, events, or phenomena that have a location on the earth. The location may be static in the short-term, like the location of a river an earthquake events, road, malnutrition among children, or dynamic like a moving vehicle or pedestrian, the spread of an infectious disease. Geospatial data combine location information, attribute information and often also temporal information or the time at which the location and attributes exist. Geospatial data usually involve information of public interest such as road, localities, rail lines, water body, and public amenities.

AHP techniques (Analytical Hierarchy process)

This process introduced by Thomas L.saaty in 1970s. It is a quite simple but powerful process for taking any logical decision in wide variety of field of application. It is also known multi-criteria decision-making tool. It can be employed to solve several managerial, manufacturing and production related decision-making problem.

Analytic hierarchy process (AHP) coupled with GIS software can be used in structure and transparent way for analysis of spatial data. (Feizizadeh and Blaschke, 2013; Suarez-vega et al., 2011).AHP are effective tools frequently applied along with GIS and RS for qualitative and quantitative analysis in water recourses management (Sahu et al.,2022)

Review of literature

Gaikwadet.al., (2021)studied delineation of groundwater potential zones using vertical electrical sounding (VES) in a complex bedrock geological setting of the west coast of India, the study reveals that the construction of water harvesting structures along the VES points will helpful in the development of groundwater recourse management.

sahu et.al., (2022) analysing Applications of geospatial analytical hierarchy process to identify the groundwater recharge potential zones and suitable recharge structures in the Ajani-Jhiri in India, the study reveals that to identify potential zones groundwater recharge zones .they studded helpful for policymakers and water professionals in the development of watershed.

Mukute et.al (2019) studied Understanding the influence of industrial and agricultural land uses on ground water quality in semiarid region of solapur. Hydro-chemical results conforms that groundwater is slightly alkaline and hard to very hard type. It contains TDS, Na, Ca, and K concentration in groundwater. It is unsuitable for drinking during both seasons.

Wagh et.al (2019) studied Assessment of groundwater quality in Aundha Nagnath Town Maharashtra using Water Quality Index, the study reveals that the groundwater quality of study area is influenced due to improper management of sewerage, domestic waste water and leaching of nutrients in shallow aquifers.

Study area

The study area cover approximately813.17 km^2southern part of the Hingoli district, Marathawada region of the Maharashtra state and bounded with 76°86’ to 77°24’ longitude E

and 19°40’ to 19° 71’ latitude N covered under survey of India (SOI) toposheets numbers 56A/11,56A/12, 56A/14, 56A/16 and 56E/2, 56E/3, 56E/4 on the 1:50,000 scale. The major catchment of the study area covered by Godavari River and it absorbs river flows as purna, asna, and some small part by Kayadhu river of penganaga catchment, associated to drainage network are dendritic to sub dendritic. Physio-graphically terrains exhibits the elevated mountain of Ajanta hill range with Hogoli plateau of moderate to low towards south slope and elevation ranges from 561m to 304m (AMSL). The relief of the terrain is 257m (AMSL) towards south and southwest. The climatic condition are dry except during southwest monsoon,annual rainfall is around 750 to 900mm. Geologically, the area is dominated with Deccan with Deccan Basalt of upper cretaceous to Lower Eocene and alluvial unconsolidated material of recent period. Solis of the study area derived from the parental rock Deccan basalt. The central, southern and eastern part of the tahsil depth range 1 to 2m black soil with reach plant nutrients and Purna River are alluvium soil is thicker. This area is almost has deep black soils and main crops cultivation are soybean, jawar, bajari, wheat, pulses, and sometime sugarcanes. The canal irrigation system of the siddeshwar is well developed in the study area. As per 2011 censes record 122 village fall under this tahsil.

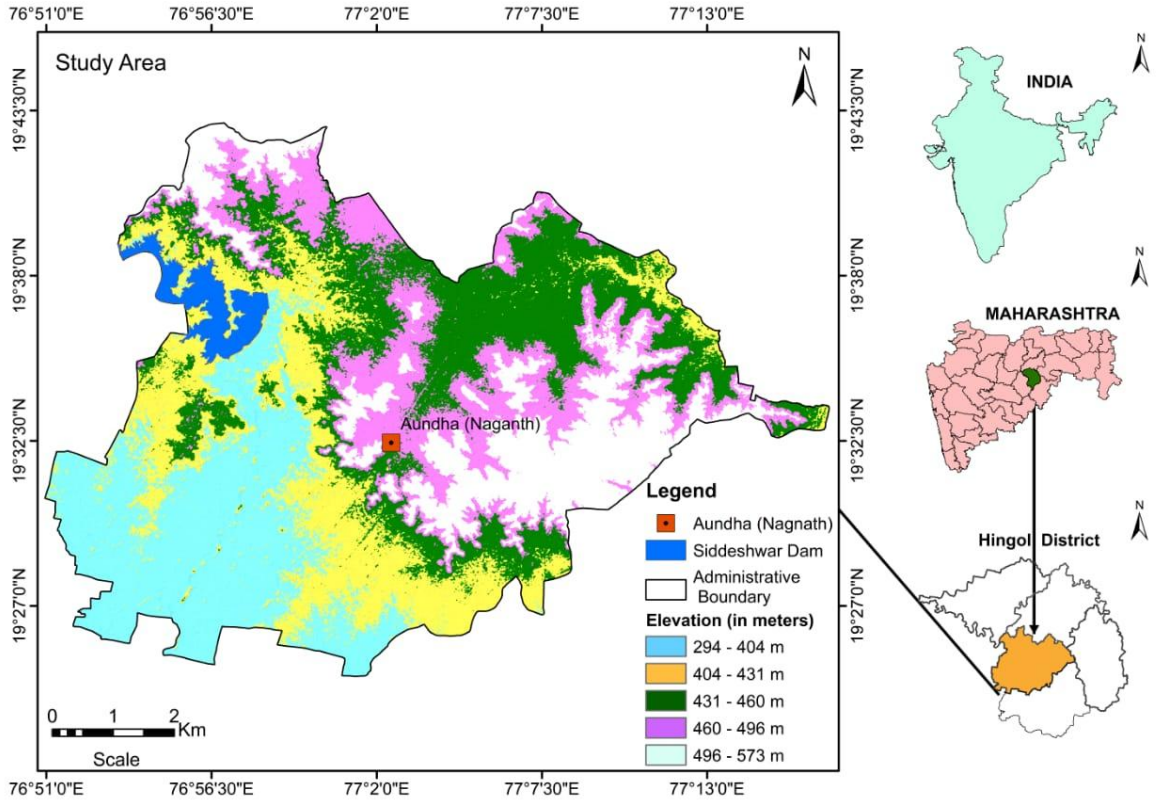

Fig.1 Study area map of Aundh (Nagnath) Tehsil

Objective

1. To prepare the thematic maps of the study area such as drainage density, lineament, geology, geomorphology, land use and land cover, soil, etc. from SOI and satellite data.
2. To delineate groundwater potential zones in the Aundha Nagnth tehsil for identifying suitable recharge structures using geospatial tools and AHP techniques.
3. To collection of groundwater observatory wells (Dug/Bore) and representative water samples from study area to analyse the water quality parameters and its spatial distribution using geo-spatial methods.
4. To use of statistical analysis tools to interpret groundwater quality and influencing parameters which alter water quality.
5. To generate groundwater potential map by integration of various factors like thematic data-sets and suggest the suitable recharge structures in the study area.
6. To suggest remedial measures to problematic aquifers to enhance ground water quality in study area.

Methodology

Representative groundwater samples will be collected form dug well/bore well/hand pumps from the study area during pre and post monsoon seasons by considering geology,geomorphology, land use land cover (LULC),accessibility etc. Global positioning system (GPS) will use to record the location coordinates of the sampling sitesand preparation of base maps thematic maps. The pH and electrical conductivity (EC) will measure in situ by using portable digital meter. The gravimetric method will used for the analysis of Ca,Mg,CO_3, HCO_3 and CI by following standard procedures of American public Health Association(APHA, 2005). The Na and K ions will analyze using flame photometer and SO_4will determine using spectrophotometer. Initially, preparation of vector base thematic maps from survey of India (SOI) toposheets and GIS quadrangle maps 1:2,50,000 scale(56A &56E) such as drainage,litho logy, geomorphology, structural,Land use land cover (LULC)based on the satellite images interpretation of techniques. Extraction of terrain features like DEM, slope (%) from ASTER GDEM 30 m raster data is computed by GIS spatial analyst extension tools. Also collection of rainfall, temperature, humidity data etc from concern agencies to interpret environmental condition in the study area. To define the strategies for the adequate fields work will be carried out in pre and post monsoon periods for collection of groundwater observatory data to validate map interpretation. Incorporation of field observation data, lithology, structural information, and geomorphology, hydrogeology, base overlays etc. Determination of water recourse based on attributed like rainfall, water table depth, depth of well, aquifers, recharge, drawdown, canal, and fluctuation of groundwater with IDW interpolation techniques in GIS software. To classify high, moderate

and low groundwater potential zones and proper recharge structures for enhance groundwater table within the study area.

Importance of the study

International status: Groundwater plays a key role in meeting the water needs of various user sectors in the all country. First international conference on groundwater quality research, at rice University in October 1981.several studies provide an overview of the chemicals and microbial contamination (John et.,al 1985). Roughly 60% of global groundwater use is for irrigation most of the rest is used in household and industry. Groundwater uses vary significantly by country, and partly depend on climate. Globally, over 2 billion people use groundwater as source of drinking water. In some countries such as Pakistan,Saudi Arabia, and Syria, irrigation accounts for 90% of groundwater use (National ground water association).

National status : Groundwater has become a more important and reliable source of fresh water for potable and agricultural uses in India. Access to safe drinking water remains a vital requirement, as in India, where 30% and 90% of urban and rural population still depend on both surface and groundwater resources(kadam et.al 2005). In recent years, public reliance on groundwater in India for drinking and irrigation uses has been amplified due to deterioration in quality and in adequate quantity of surface water recourse. In India the net groundwater availability is 399 billion cubic meter. The annual groundwater draft is 231 billion cubic meters (bcm); 213bcm is used for irrigation and 18bcm is utilized for domestic and industrial use (CGWB 2006). In India, it estimated that per capita water availability was 2309meter cubic. In year 1991 and it was depleted to 1902 meter cubic in year 2001.it is projected to reduces in year 2025 and 2050 by 1401meter cubic and 1191meter cubic, respectively. The SERT (2009) reported that most part most part of India will face a severe water scarcity by 2050.

Significance of the study

By assessing groundwater potential zones in the study area will help to identification future threats to groundwater level and this will help to frame the groundwater policy makers to prepare groundwater conception policy according to study results.

Work plan:

1) Reference work related with groundwater quality of the proposed area.
2) Geological mapping and Morphometric analysis of study area using G.I.S. software.
3) Based on environmental, geological, hydro geological and geomorphologic factors establishment sampling sites and collection of Pre-monsoon and Post-monsoon groundwater samples and analysis by using standard chemical methods.

4) Analysis of groundwater and surface water samples. Preparation of thematic maps by using GIS software to correlate the pollution sources with groundwater in the study area.

5) Identifying the environmental effects of groundwater contamination.

6) Delineation of groundwater potential zones in the study area for identifying suitable recharge structures using geospatial tools and AHP techniques and generate groundwater potential map of the study area.

Structure of research work

Time (Month)	Work
00-06	Review of literature
01-24	Field work / data collection
24-36	Data interpretation. Writing of thesis, publication writing.

Reference

APHA (2005) Standard methods for the examination of water and wastewater, 21st edn. American Public Health Association, New York

Allafta, H., Opp, C., & Patra, S. (2020). Identification of groundwater potential zones using remote sensing and GIS techniques: a case study of the Shatt Al-Arab Basin. Remote Sensing, 13(1), 112.

CGWB Report (2010) Unpublished report on ground water resources and development potentials of Hingoli district, Maharashtra.

Dehghanpour, H., Lan, Q., Saeed, Y., Fei, H., & Qi, Z. (2013). Spontaneous imbibition of brine and oil in gas shales: Effect of water adsorption and resulting microfractures. Energy & Fuels, 27(6), 3039-3049.

Gaikwad, S., Pawar, N. J., Bedse, P., Wagh, V., & Kadam, A. (2021). Delineation of groundwater potential zones using vertical electrical sounding (VES) in a complex bedrock geological setting of the West Coast of India. Modeling Earth Systems and Environment, 1-15.

Herrera- Pantoja, M., & Hiscock, K. M. (2008). The effects of climate change on potential groundwater recharge in Great Britain. Hydrological Processes: An International Journal, 22(1), 73-86.

Kadam, A., Wagh, V., Patil, S., Umrikar, B., & Sankhua, R. (2021). Seasonal assessment of groundwater contamination, health risk and chemometric investigation for a hard rock terrain of western India. Environmental Earth Sciences, 80(5), 1-22.

Kumar, D. M., & Shah, T. (2006). Groundwater pollution and contamination in India: the emerging challenge (No. H043613). International Water Management Institute.

Kumar, K. R., Sahai, A. K., Krishna Kumar, K., Patwardhan, S. K., Mishra, P. K., & Revadekar, J. V. (2017). Delineation of Groundwater Potential zones in Pingalgarh Watershed of Maharashtra State using Geospatial Techniques. Journal of Agriculture Research and Technology, 42(3), 65.

Mays, L. W., & Todd, D. K. (2005). Groundwater Hydrology. John Wily and Sons, Inc., Arizona State University, Third addition.

Mukate, S., Panaskar, D., Wagh, V., Muley, A., Jangam, C. and Pawar, R., (2017). Impact of anthropogenic inputs on water quality in Chincholi industrial area of Solapur, Maharashtra, India. Groundwater for Sustainable Development..https://doi.org/10.1016/j.gsd.2017.11.001

Mukate, S. V., Panaskar, D. B., Wagh, V. M., & Baker, S. J. (2020). Understanding the influence of industrial and agricultural land uses on groundwater quality in semiarid region of Solapur, India. Environment, Development and Sustainability, 22(4), 3207-3238.

Ramachandra, M., Raghu Babu, K., Rajasekhar, M., & Pradeep Kumar, B. (2019). Identification of groundwater potential zones using AHP and geospatial techniques in western part of Cuddapah Basin, Andhra Pradesh, India. Hydrospatial Analysis, 3(2), 60-71.

Sahu, U., Wagh, V., Mukate, S., Kadam, A., & Patil, S. (2022). Applications of geospatial analysis and analytical hierarchy process to identify the groundwater recharge potential zones and suitable recharge structures in the Ajani-Jhiri watershed of north Maharashtra, India. Groundwater for Sustainable Development, 17, 100733

Waikar, M. L., & Nilawar, A. P. (2014). Identification of groundwater potential zone using remote sensing and GIS technique. International Journal of Innovative Research in Science, Engineering and Technology, 3(5), 12163-12174.

Wagh, V., Kharjule, S., Mukate, S., Pawar, R., Aamalawar, M., & Varade, A. M. (2019). Assessment of Groundwater Quality in Aundha Nagnath Town, Maharashtra using Water Quality Index. Journal of Geosciences, 4(1), 61-66.

Wagh, V. M., Panaskar, D. B., Jacobs, J. A., Mukate, S. V., Muley, A. A., & Kadam, A. K. (2019). Influence of hydro-geochemical processes on groundwater quality through geostatistical techniques in Kadava River basin, Western India. Arabian Journal

Wagh, V. M., Panaskar, D. B., Mukate, S. V., Gaikwad, S. K., Muley, A. A., & Varade, A. M. (2018). Health risk assessment of heavy metal contamination in groundwater of Kadava River Basin, Nashik, India. Modeling Earth Systems and Environment, 4(3), 969-980.

Arihant Publication book

www.google.com.

Signature **Signature**

Vaishnavi Sahebrao Raut **Dr. Vasant wagh**

Research scholar **Research supervisor/Guide**